

*TEACHING COIN DISCRIMINATION TO CHILDREN WITH
VISUAL IMPAIRMENTS*

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We taught 2 children with visual impairments to select a coin from an array using tactile cues after hearing its name and then to select a coin after hearing its value. Following the acquisition of these listener (receptive language) skills, we then observed the emergence of speaker (expressive language) skills without direct instruction.

Key words: children, coin discrimination, visually impaired

Successful monetary exchanges involve a number of component skills, the most rudimentary of which include discriminating between the units of currency and identifying the value of individual denominations of currency. For example, Miller, Cuvo, and Borakove (1977) taught 30 preschool-aged children of typical development to state the name of a coin or to select coins from an array after hearing their stated names. In common practice, children are taught to discriminate coins based on visual characteristics (e.g., the color, size, texture, and engraved images unique to each coin); however, these visual features will not be useful for engendering discriminated behavior among individuals with severe visual impairments. Rather, teaching procedures for this population need to focus exclusively on tactile features of the coins (Baer, 1995). American coins differ in terms of relative size and the presence or absence of ridges. Although teachers of the visually impaired have taught these relations successfully in many cases using prompting and praise for correct respond-

ing, we have not identified any research that has evaluated these procedures. By specifically targeting certain listener (receptive language) skills, teachers may be able to promote the emergence of speaker (expressive language) skills without direct instruction.

In the current study, we taught children the listener skills of selecting a coin from an array based on its size and the presence or absence of ridges relative to the other coins in the array when presented (a) with its name, and then (b) with its stated value. We then assessed the emergent speaker skills of stating the name and value of each coin when presented with the actual coin, its name, or its value.

METHOD

Participants and Setting

We solicited nominations for participation from the staff of a state school for children with visual impairments. Maddie was a 6-year-old girl of typical cognitive development who had been diagnosed with oculocutaneous albinism with horizontal nystagmus and photophobia. Chris was an 8-year-old boy with mild developmental delays; he had been diagnosed with retinal detachment in both eyes (specifically retinopathy of prematurity), a dense cataract in his left eye,

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and no light perception in his right eye. Both participants' diagnoses were obtained from their school records. We conducted sessions in an empty therapy room at the school or a secluded area in their classrooms.

Measurement and Interobserver Agreement

During trials that required a selection response, we defined *correct responding* as placing the target coin in the teacher's hand within 5 s of the teacher's instruction. During trials that required a vocal response, we defined correct responding as vocalizing the target coin's name (or value) within 10 s of the teacher's instruction. To assess interobserver agreement, a second observer simultaneously but independently collected data during 81% and 85% of Maddie's and Chris's sessions, respectively. We compared observers' records on a trial-by-trial basis and scored each trial in agreement only if both observers' records matched identically. Observers agreed on 97% and 96% of trials for Maddie and Chris, respectively.

Coin Relations Pretest

We conducted pretest probes to assess the children's abilities to state the name of a coin (i.e., penny, nickel, dime, and quarter) given the coin as a sample stimulus (coin-name relation), to state the value of a coin (i.e., 1 cent, 5 cents, 10 cents, and 25 cents) given the coin (coin-value relation), to state the value of a coin given the name (name-value relation), to select a coin from an array of the four coins given its name (name-coin relation), to select a coin given its value (value-coin relation), and to state the name of a coin given its value (value-name relation). We assessed each relation during an individual session (i.e., a total of six pretest sessions; one session for each relation); each session consisted of eight trials in which we presented each coin as the target twice. We did not provide any feedback or differential consequences based on the accuracy of responding. We initially conducted only a single session probe of each relation to ensure that children did not respond accurately.

Discrimination Skills Assessment and Training

We conducted an assessment to determine if children could discriminate larger from smaller coins (size assessment) and the presence or absence of ridges (ridges assessment); these skills were prerequisite to teaching coin-name-value relations based on tactile features. This size assessment consisted of 12 trials. During each trial, the teacher presented the student with two American coins and instructed the student to hand her either the larger or the smaller coin. The teacher presented each coin paired with every other coin twice per session (once in which the teacher requested the child hand her the larger coin and once in which she requested the smaller coin). The teacher did not provide any programmed consequences for correct or incorrect responding. Participants who responded correctly during 11 out of 12 trials were deemed to have mastered this discrimination; those who did not demonstrate mastery received additional instruction prior to coin-relation training (described below).

The ridges assessment consisted of eight trials in which the teacher presented two coins (one with ridges and one without; she presented each pair twice) and asked the child to hand her the coin either with or without ridges. Participants who responded correctly during seven of the eight trials were deemed to have mastered this discrimination; those who did not demonstrate mastery received additional instruction prior to coin-relation training. Maddie met criteria for ridges versus no ridges but required training in the larger versus smaller discrimination. Chris required training for both size and presence or absence of ridges.

Training sessions for size discrimination were similar to test sessions, except that the children were prompted (a) to place both coins next to each other in their hands, (b) to touch the edge of the smaller coin, and (c) to hand the larger or smaller coin to the therapist. Correct responding at each step in the sequence resulted in teacher praise, and completion of the terminal

step resulted in the delivery of a marble dropped in a cup to produce an audible sound. Each marble was exchangeable for 30-s access to a preferred leisure item at the end of the session. Incorrect responses or a failure to respond at any step resulted in physical guidance from the teacher.

Training sessions for ridges discrimination were similar except that children were prompted (a) to pick up each coin individually, (b) to drag their fingernail along the side of the coin, (c) to vocally label the coin as having or not having ridges, and (d) to hand the requested coin with or without ridges to the teacher.

Training sessions continued until the participant met criteria on 11 of the 12 trials during size-discrimination sessions and on seven of the eight trials during ridge-discrimination sessions. Each criterion was achieved following two sessions of direct instruction across skills and participants. We completed an additional post-training probe under pretest conditions the following day to ensure that this skill persisted in the absence of prompting and differential reinforcement; correct responding continued in this follow-up assessment in each case.

Coin-Relation Training

We initially conducted additional coin-relation baseline sessions using procedures identical to those described in the coin-relation pretest to establish a baseline level of accurate responding in each coin relation. We then implemented relation training in a multiple baseline design across relations. We first implemented name-coin training, in which we presented the spoken name of the coin as the sample stimulus and targeted handing the coin to the teacher from a comparison array consisting of all four American coins laid side by side as the terminal response. Each session consisted of eight trials. We initiated each trial with the prompt, "find the [name of coin]."

We used an errorless teaching procedure to facilitate acquisition of these relations. During the first session of the name-coin relation

training sessions, we presented only the target coin in the comparison array (e.g., the penny). Correct independent responding resulted in the delivery of praise and a marble. If the child did not engage in a correct independent response within 5 s of the trial-initiating prompt, we physically guided the child (a) to pick up the coin, (b) to drag a fingernail along the outer rim of the coin, and (c) to hand the coin to the teacher. Correct prompted responses resulted in praise only. After one session in which the child completed these steps independently on seven of the eight trials, we introduced one additional comparison into the array that differed in the presence or absence of ridges (e.g., the dime would be presented along with the penny). Training was similar except that we prompted the participant (a) to stack the coins to identify size differences, (b) to drag a fingernail along the outer rim of each coin, and (c) to hand the target coin to the teacher. Following one session in which the child correctly and independently identified the target coin on seven of the eight trials, we then introduced a third coin. We used the same training steps and criteria to add the fourth coin. After meeting criteria for the first coin with a full comparison array, we then introduced the next coin as the target and repeated the previous training steps (i.e., only one comparison presented) until all four coins had been selected with at least seven of eight correct trials given their names as sample stimuli. After the child mastered the name-coin relation, we conducted emergent relations probes (described below) for each of the coin relations. Following these probes, we implemented value-coin training using the same errorless training procedure described above, except that the initial prompt during this training was "find the [value of coin]."

Emergent Relations Probes

Following mastery of the name-coin relation and again following mastery of the value-coin relation, we conducted probes of each of the six coin relations. Each probe session targeted one coin relation and consisted of 16 trials. Eight trials were identical to those in the pretest (i.e.,

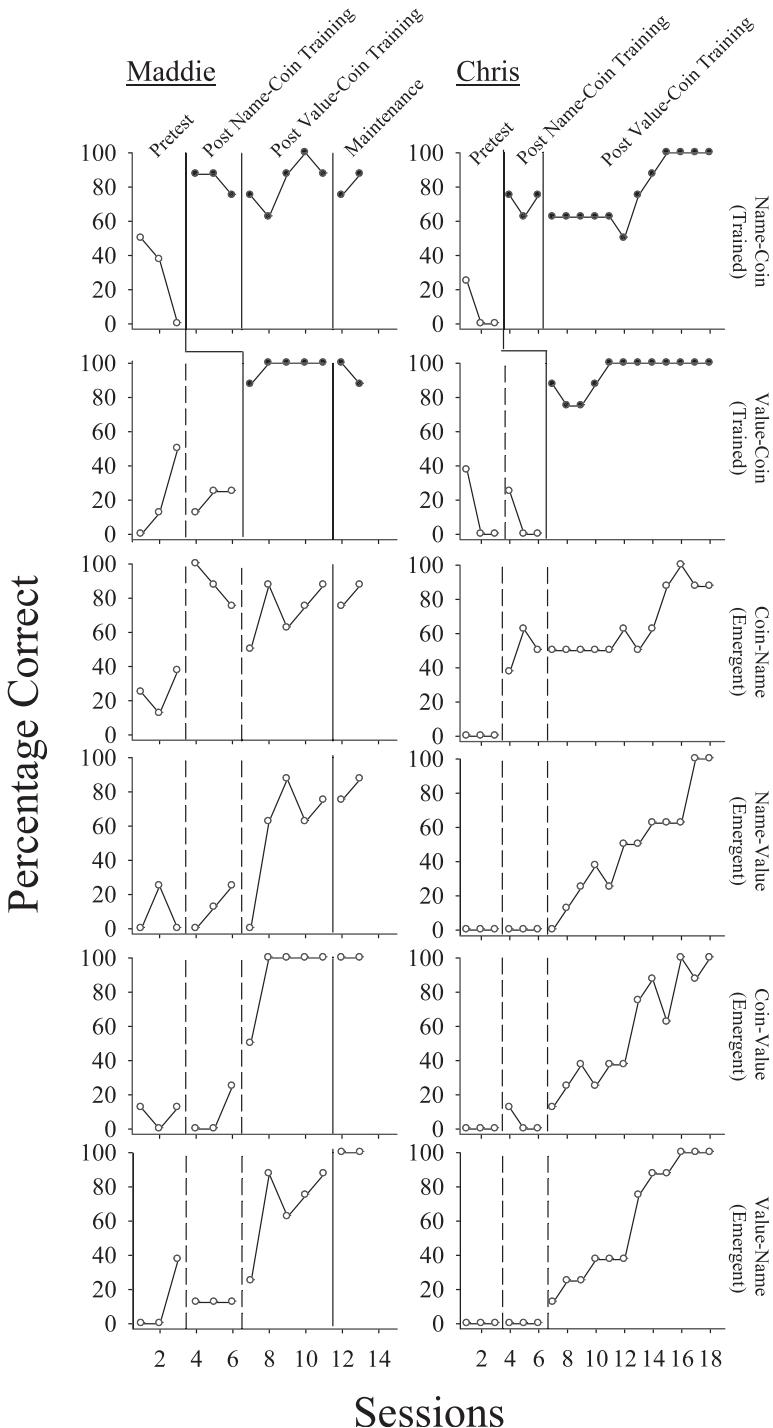


Figure 1. Trained and emergent relations for Maddie and Chris.

responding did not result in reinforcement), and eight trials were identical to those of the coin-relation training sessions (i.e., correct responding resulted in reinforcement delivery); we report data only from the unreinforced probe trials. This procedure prevented prolonged periods of nonreinforcement for responding and maintained the trained relation at strength during these probes.

RESULTS AND DISCUSSION

Maddie's correct responding during the name-coin and value-coin pretest probes was low (first phase on the top two panels of Figure 1). She met all mastery criteria for the name-coin training relation within 16 instructional sessions in which she did not make a single error during 128 instructional trials. She then engaged in higher levels of accuracy during the posttraining name-coin probes (data to the right of the first phase line). At this point, we also observed large increases in the coin-name relation; all other relations remained at their pretest levels. We then implemented instruction for the value-coin relation; Maddie again met mastery criteria for this relation without engaging in a single incorrect response during 16 sessions. She continued to respond accurately during postinstruction probes. Concomitant with her increase in accuracy of this trained relation, we also observed increased accuracy in the probes for the coin-value, name-value, and value-name relations. We then conducted a maintenance probe 5 months following the completion of this evaluation; Maddie continued to respond with high accuracy in each relation.

Chris responded correctly at low levels during the pretest probes of the name-coin relation. He met all mastery criteria in this relation after 21 instructional sessions during which he made a total of 13 incorrect responses across 168 instructional trials. His correct responding was maintained during posttraining name-coin probes. Training also was associated with increased accuracy in the coin-name relation.

His correct responding remained low during the value-coin probes. We then directly instructed responding in this relation; Chris met mastery criteria after 17 sessions of instruction, during which he made only three incorrect responses across 136 trials; his correct responding increased during posttraining probes. We also observed increased accuracy in the coin-value, name-value, and value-name probes. We did not conduct maintenance probes with Chris.

In summary, we taught two children with visual impairments to select accurately among the four American coins given both the coin name and the coin value as relevant sample stimuli via an errorless instruction program that was targeted specifically on the tactile features of each coin. In addition to these targeted listener (receptive) skills, we observed the uninstructed emergence of the coin-name, coin-value, name-value, and value-name relations as speaker (expressive) skills.

The current study is unique in that it (a) provided a systematic means by which to teach coin-identification skills to children with visual impairments, (b) demonstrated the transfer of listener to speaker skills (see also Greer, Stolfi, Chavez-Brown, & Rivera-Valdes, 2005), and (c) demonstrated the transfer of stimulus control across sensory modalities (visual, auditory, and tactile). It should be noted that these participants were not likely to have complete monetary-usage repertoires as a result of this training. Monetary skills would require the students to identify coins when the complete array was not present for relative comparison (which we did not assess) and to sum various denominations of coins to arrive at a targeted value (which we did not target, but see Lowe & Cuvo, 1976). Further, it will be important to assess monetary usage in common situations to determine the utility of acquired monetary skills (e.g., purchasing a beverage at a vending machine).

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